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THE JOURNAL OF PHILOSOPHY

NATURE AND CONVENTION

DISTINCTIONS recognized abstractly are often forgotten in the presence of a living subject-matter, or what is perhaps worse, erected into radical oppositions so that the existence of nature as well as of successful inquiry is made a mystery. The history of thought is replete with attempts to lay the universe on the procrustean bed of one of several elements of analysis. Whether nature is a unity or a plurality, a flux or an unchanging whole, temporally complete or unfinished, whether haphazard or whether there is determination in her manifestations, are a few of the more obvious themes upon which speculative thought has played its variations. But the striking resolutions of problems of this genre have usually pointed to the false antitheses or exclusiveness of the premises, and have attempted to render justice to the complexity of the subject-matter as well as to its unity, by softening the oppositions of dialectic dissonances. For a philosophy which renounces every claim to dictate the characters nature should possess, and which pretends to nothing more than the description of discovered traits, it is a sound maxim to renounce as well habits of analysis which convert distinctions that are the achievement of an inquiry into "necessary conditions," for the existence of the subject of inquiry, or which interpret such distinctions as impermeable walls by means of which a plurality of traits are irrevocably separated.

Recent work in the sciences has brought into prominence the importance of initial agreements, particularly as to measurement, for the subsequent formulation of physical theories. Indeed, not the least important of the morals to be drawn from the recent scientific revolution, is the fundamental role of definition.[1] There have not been lacking the most radical interpretations for this condition. For some, the inescapable function of the "human foreground" and an abhorrence of anthropomorphism in science, has been made the ground for waving aside individual perspectives on nature as illusion, and for inviting a dumb adoration of her incomprehensible processes. For others, the dependence of the generality of physical theories upon

[1] *Cf.* excerpt from letter from Einstein, in *Logos*, X, 1921, p. 354.

particular modes of investigation has fortified a sensationalistic empiricism, and the disruptive alternative between nature and convention has been invoked with as much vigor as in antiquity. "Die Tatsachen sind das 'Natürliche,' die Theorien die 'Kunst,' " writes Petzoldt. And, of course, the ease with which "mind" has always been called upon to account for whatever needed explanation, has found its echo in the theory which makes the creative activity of mind the source of the diversity of nature.

Failure to hold on to the distinction between what is particular and what is relational, between what is taken for granted and what is to be demonstrated in a given context, is bound to produce difficulties. Failure to remember that categories like individuality and continuity are distinctions in analysis, and that *in rerum natura* each demands the other, is sure to cause confusion. It is the object of this paper to show that some difficulties may be escaped by a recognition (1) that agreement upon the matter of inquiry, that is, some form of specificity, enters into all cases of knowledge, (2) that arbitrariness of approach has a restricted scope and reduces itself to the recognition of an ultimate diversity in the nature of things, (3) that knowledge of nature is possible precisely because there are more or less isolable fields for inquiry, and (4) that particularity or specificity, and generality or connectiveness, are distinctions within a subject-matter, not irreconcilable oppositions.

I

Attempts to arrive at first principles have been too often exercises in proof by *reductio ad absurdum* when for logical analysis a genetic psychology has been substituted, and when in the course of analysis logical primitives have been introduced which are tantamount to a repudiation of the subject-matter of the inquiry. The history of epistemological theories, which in the last century culminated in a widely accepted agnosticism as to the reality of the external world, is the record of fallacies of this order. In much contemporary thought, too, the quest for a doctrine which would make "valid" the procedure of science has led to the *impasse* of a dualism of "hard," psychologically primitive sense data utterly disconnected and unattached, on the one hand; and a relational complex known independently of the conceptually impoverished perceptual elements, on the other. The difficulties experienced in "building up" the external world, which presumably was the source of the problem, ought to indicate that to use wholesale scepticism as a method for discovering the truth, is hopelessly vain.

As a matter of fact, of course, whenever an inquiry is going on there is taken for granted a large body of knowledge, which in *that*

inquiry must remain unquestioned. One of the early methods of determining the elementary electric charge, for example, assumed among other things a relation known as Stoke's Law connecting the velocity and size of a falling liquid drop, a law which was *subsequently* shown to be invalid for the circumstances of the experiment. It need scarcely be said that the modifications introduced to correct the law took for granted *other* relations unquestioned in the new context. Indeed, when one takes a definite case of the acquisition of knowledge as the starting point for an epistemology, the usual distinctions involved in discovering how valid knowledge (in general) is possible, are recognized as artificial, extraneous to the demands of the actual process of inquiry. The attempt to derive knowledge *from* sensation, or the converse folly of trying to foist an *a priori* relational structure *upon* sensations, results from a failure to realize that no inquiry is significant unless framed in a wider realm of accredited knowledge. Laws taken for granted at one stage of investigation are, of course, not sacrosanct, and may be revised; but the revision can be performed only if other uniformities are used with some confidence. The road to truth is not a marble stair where security of position is guaranteed by a *single* well-laid foundation. It is a treacherous, unblazed path where security of step is *never* guaranteed, and where whatever assurance is obtained is secured by the interplay of *many* elements, independently founded, seldom linearly dependent.

What are the logical elements in scientific inquiry? In a relatively complete science, such as mechanics, it is possible to set up a formal list of definitions and axioms, and to elaborate these without any appeal to experiment *more geometrico.* It is too readily overlooked that apart from a reference to existent physical objects ultimately defined denotatively, such an axiomatic is a branch of pure mathematics, and becomes mathematical *physics* only by virtue of an "interpretation" which assigns empirical objects and empirical associations between them to the terms and operations of the formal scheme. From the point of view of the completed deductive system, the assignment of certain objects rather than others to the terms of the theory is arbitrary, while from the point of view of objects divorced from any relational scheme the fact that objects do "satisfy" any scheme seems a mystery. The connection between empirical objects and terms of a physical theory rests, of course, in the fact that in so far as we *think* of objects it is not in their brute immediacy that they are objects of knowledge, and that in constructing physical theories the relations which physical objects bear to one another are the models for an analogy.[2]

[2] Campbell, *Physics*, p. 129. *Cf.* also Gonseth, *Les Fondements des Mathematiques*, Chap. 7.

Many years ago Peirce made clear that our ideas are to mean all the experimentally verifiable consequences which follow our acting upon them. Since Peirce was bred in the laboratory and since his philosophy was largely a crystallization of scientific method, it is not surprising that critically conscious scientists should have, independently, voiced a full-throated endorsement of many of his positions.[3] In great detail N. R. Campbell has shown that terms in common usage as names for objects, depend for their significance upon verifiable uniform associations between certain qualities, and that apart from the existence of such associations or laws within the domain where these terms find their application, we court error and talk nonsense.[4] The extension of terms to new situations involve the *experimental* determination of the existence of corresponding laws.

Vagueness of meaning is removed when measure-numbers can be introduced with a complete specification what operations are involved with each number assigned. Qualities that do not permit of precise measurement can not play a leading rôle in physical inquiry, while qualities that do are replaced by the methods of their numerical determination. That qualities which can not be easily and directly distinguished are associated with qualities which are more easily manipulated and capable of sensitive discrimination, is an important fact about nature: it makes science as a project for obtaining knowledge and control possible. But this fact should not be converted into a denial of qualitative differences, or used to impoverish the qualitative wealth of nature by reducing it to three or four measurable characters. However, it is sufficient for the purposes of scientific inquiry to identify terms with the methods of determining them. With Bridgman we may say that "the concept is synonymous with the corresponding set of operations."[5]

When a quality is operationally defined, not *all* of the conditions of the experiment are stated explicitly, and no *a priori* reason can be given for excluding the particular time, locality, or experimenter from the list of controlling factors. That not the entire state of the universe need be taken into account in performing experiments, that several experiments may be judged to be the "same" in spite of certain other differences, that there are relative constancies in terms of which changes may be predicated, is a condition for all discourse. So also, it may be urged, the "weight" we determine with a beam balance is not the same (since by definition the operations involved are different) as the "weight" determined with a spring balance. Nor is the "charge" of an electron the same when determined by

[3] *Cf.* Eddington, *Mathematical Theory of Relativity*, pp. 3–4.

[4] *Physics*, Chap. 2.

[5] *Logic of Modern Physics*, p. 5.

means of the study of Brownian movements as when it is determined with the "balanced drop" method: and yet we believe we are measuring the *same* thing. It is not difficult to raise such objections, but only by neglecting to note (1) that operations selected must be capable of indefinite repetition and that hence it is a *series* of operations which is the *definiens,* (2) that objects which enter into the set of operations have a qualitative nature not exhausted by the relational structure of which they become parts, (3) that the fundamental magnitudes, in terms of which all other measurables are determined, are characterized not only by certain transitive assymetric relations, but must be capable of submitting to a *definite* operation of "addition," and (4) that it is the qualitative homogeneity in the latter which is the basis for identifying magnitudes not identically defined.[6]

It is certainly the ideal of science to make the explicit formulation of its results in the form of theories exclude any reference to human associations. The nature of particular inquirers, the motives which led them to make discoveries, are completely irrelevant. Yet the desire so to state the *outcome* of inquiry that would make that outcome independent of its *processes* and *rules,* is vain. Were the fabled Martian, innocent of earthly ways, to be confronted with the formulated doctrines of earth-bound men, his understanding and recognition of the validity of science would be miraculous unless the specific physical operations which constitute the meaning of the terms of discourse would also be revealed. A view of nature which defines that to be *real* which is constant and invariable for all observers,[7] is as legitimate as any, but apart from reference to specific qualitative differences, to specific human ways of behavior, the structure of science is a ghostly thing, an empty play of symbols.

That definitions in the form of a series of physical operations can be made, betrays something about nature as well as about ourselves. It discloses individualized, denumerable processes, capable of indefinite repetition, capable of quantitative analysis. It discloses that we are capable of turning away from the poignancy of the qualitative immediacy of nature, and that by interacting with those processes we can discover linkages in the interest of perpetuating these qualities. That these linkages are in a sense subterranean and not obviously connected with the surface play of qualities, and that, as a consequence, science is not a photographic reduplication of nature, has raised the objection that it is to the intervention of human agency the outstanding uniformities of nature are attributable, that our knowledge of nature is "conventional." We turn to an examination of what conventions are.

[6] Campbell, *Measurement and Calculation,* pp. 8 ff. and 38 ff.
[7] Planck, *Physikalische Rundblicke,* p. 34.

II

(*a*) An analysis of some current meanings of the word "convention" should lay bare certain minimum features common to all. The most obvious and primitive of such meanings is the act of coming together for purposes of deliberation, instruction, amusement, or recreation. The nature of such meetings is as diverse as the reasons for their existence. In every case, however, conventions in this sense are responses to particular human needs. What the *consequences* of conventions are, are functions not only of those needs, but of the exigencies of the subject-matter through which they are satisfied. They may result in the coördination of activities, the destruction of barriers to communication, or the realization of hitherto unemployed potencies. It is not customary to designate conventions as arbitrary. But if they are to be so considered, arbitrariness devolves upon them either because of the particular field within which their concern lies (and then arbitrariness is identical with the diversity of existential traits), or because of the particular course of action in which they issue. Now action entered upon with an eye toward removing a prior need is the result of deliberation, and whether the act selected fulfills the need which prompted its choice is not the result of a *fiat*. The rôle of deliberate choice is the rôle of any hypothesis, and in so far as conventions exist to solve particular difficulties, their arbitrariness is that implied in the existence of thought.

Conventions as general agreement, contract, customary rule, are an outstanding feature of every civilization. Indeed, they have been identified as the agents of a liberating morality.[8] It is difficult to draw clear lines of demarcation between activities purely physiological and those of conventional origin. And yet the very existence of such customs or habits becomes inexplicable if divorced from the compulsion which the nature of the things exercises upon the agreements of men.

The well-known example of the traffic rule is much to the point. The rule, it is said, is arbitrary, since there is nothing in the nature of things apart from human purposes to prevent vehicles from using the left side of the road. It is relevant to point out that the very form of the objection implies a sharp separation of human activity from the rest of nature and that consequently any instance of volition is a *deus ex machina* involving the usual mystery attending a supernatural event. Now rules arise out of specific discontinuities in human affairs, and serve as compromises or devices to bridge such gaps. Subject-matter must be recognized if rules are to be effective.

It may be retorted that, granting all this, it is still arbitrary that we designate the right side of the road rather than the left in our

[8] Dupréel, "Convention et Raison," *Rev. de Met. et Morale*, 1925.

prescription; there is nothing in roads, or automobiles, or desires to avoid congestions and accidents, which point *uniquely* to one side rather than the other; they *point* to alternatives, but do not *dictate* the choice between them. To this the following answer seems conclusive: Whether alternative solutions are possible depends upon how closely we define the set problem. Thus the equation $x^3 + x^2 + x + 1 = 0$, for example, has *three* roots if we admit negative and imaginary solutions, *one* if our domain is that of real numbers and *no roots* if we restrict ourselves to positive integers. A problem loosely defined may present alternatives in terms of which we may *re*define the initial situation to eliminate one or more of the suggested alternatives. Alternatives which do not modify the significance of the problem to which they are solutions, are only verbally different as far as *that* problem is concerned. Consequently, the alleged arbitrariness in the existence of rules which involve a choice between alternatives, is the arbitrariness involved in having *specific* ends-in-view. Now that there are such specific ends-in-view is a fact about nature, and although the fact is local, the metaphysical status of ends-in-view is the same as the status of *any* specific characters whatsoever. One may always raise the question why (not how) a certain quality is present rather than another; but since no matter what the quality would be, the question may be put, it has the *form*, but not the *significance*, of a query. It is a safe rule that an inquiry which does not set the standards for its answers is sheer verbalism.

(*b*) These observations are too commonplace, although too often neglected, to require further elaboration. They have been introduced to point out traits present in all inquiry, and to ask recognition for the obvious fact that the universe can be approached only piecemeal, that subject-matter must be at least tentatively delimited before it can be studied, and that resolutions to pursue some one rather than another mode of inquiry must be made.

This, indeed, is the one way in which "conventional" elements appear in science. Much confusion has resulted from Poincaré's analysis of the rôle of hypotheses, in particular of the so-called "unverifiable" hypotheses in scientific method. His characterization of the choice of geometry as conventional has persuaded many that pronouncements in physics are either tautologous or capricious. Now Poincaré's point was that, essentially, a geometry is a hypothesis as to our measuring appliances, a resolution to operate upon our subject-matter in a certain manner. To ask whether a geometry is true or false of nature has no *meaning*, unless the entities and operations of "pure" geometry (i.e., certain symbols) are identified however arbitrarily with a series of empirical objects; lengths, angles,

congruence, etc., must be defined in terms of very carefully prescribed physical operations. If our geometry (really physics) now involves us in contradictions, that is if we discover that the theorems are not verified experimentally when we substitute natural objects for the symbolic scheme, and if we resolve to hold on to our original empirically defined elements, it is always possible to introduce subsidiary hypotheses, e.g., forces deforming our apparatus, and so save the consistency of our procedure. But the consistency has been won at the price of recognizing *new* factors, in our case deforming forces. Whether we separate "geometry" (the study of the relations bodies bear to one another when certain forces are not operative) and "physics" is a matter for the classification of our knowledge. We may, of course, redefine our geometrical elements to avoid the need for subsequent modification or complexity in our physics. This is just the procedure adopted in the general relativity theory. Instead of recognizing fields of force which introduce *modifications* into our measuring devices and appear therefore as something extraneous to the geometry originally proposed, the fields of force are initially introduced into the geometry by so defining its elements that throughout the domain of its relevance fields of force shall vanish.[9] It is therefore something less than the whole story to maintain that conditions of symmetry "may be entirely created by conventions as to measurement."[10] The formulation of symmetry is conventional, but, like simplicity, if not a "property of the real world" can be won only at the expense of subsequent complexity, or by a disregard of factors which ultimately compel our attention.

(*c*) Conventions are Janus-faced. For in addition to the unique nature that they possess as particular operations, they are conventions *for* a certain field of inquiry, that is, they look *toward* subject-matter; and at the same time they are directed *to* a group of inquirers, defining the point of approach in terms of which the objects of inquiry can be initially fixed. Because conventions are *for* a certain subject-matter, structure independent of human volition is implied. Because conventions refer *to* beings endowed with purpose, they are *a* way of considering subject-matter, *a* set of operations, *a* selection from the rich bosom of nature. Conventions for some*thing* are conventions for some*one*.

Conventions, like concepts, are not mere psychological affairs, *impositions* of order on an amorphous flux, whose significance is exhausted by their human reference. It is true that science is, in an obvious sense, a mental product, and that the objects of our knowl-

[9] For a detailed account, *c.f.* Reichenbach, *Philosophie der Raum-Zeit Lehre*, especially the first part.

[10] Russell, *A.B.C. of Relativity*, p. 184.

edge are not found ready made. In spite of the popularity of Baconian theories of science, students of scientic method recognize that no investigation starts with complete ignorance, but with funded knowledge in terms of which the investigation is defined and carried on. What is at our disposal at the beginning of inquiry, is a function both of the subject-matter and of the skill and imagination of the investigator. What elements may serve as data for the resolution of the set problem requires insight and experience to discover. But that the data are *sufficient* for the task is not a matter of choice or agreement, it is determined by the subject-matter as inference and experiment disclose. As against Vaihinger and his school, who find in the alleged self-contradictory nature of "fictions" a proof of their impotence to come to grips with reality in spite of their usefulness, it may be pointed out that "usefulness" as an explanatory category has been demonstrated to have metaphysical bearings as long ago as Plato of the *Cratylus.* The data of science are defined by certain operations, are modified on further inquiry, and indeed may well be said to be manufactured and would lose their meaning if separated from the inquiry for which they are designed. But the data are given certain functions because the subject-matter can be manipulated to yield them.

It is a common practice to generalize a relation experimentally determined in a certain domain by *defining* a similar type of uniformity within a more comprehensive region so that when conditions of verifiability obtain, the relation will hold. This can be seen in the history of the doctrine of energy.[11] The definition then functions as a hypothesis with which we survey and correlate events having a more extensive scope than we are capable of confirming experimentally. Such hypotheses take the form of guiding principles which may prove fertile or not in suggesting verifiable relations, but which can not be overthrown by any crucial experiment. The principle involved in the creation of such hypotheses is the same as that involved in the choice of a geometry. This shows clearly the shallowness of a philosophy of scientific method that gives central importance to crucial experiments. The distinction between fact and hypothesis is a shifting one, shifting with the context in which it operates, and with the stage of inquiry reached.

The determination of certain data for points of departure does not imply the determination of all discoverable connections. We may *virtually* select some rather than others by selecting one point of departure instead of another. But the connections we do so virtually select, only the subject-matter can decide.

The presence of conventional elements does not therefore vitiate

[11] *Cf.* Planck, *Prinzip der Erhaltung der Energie,* 5. ed., pp. 90, 111.

the procedure of science, at least not on any theory which recognizes that one may have valid knowledge without knowing everything. Knowledge may be called absolute in the sense that definite answers are discoverable to definite problems. But knowledge that is absolute in the sense of having no bearing on specific issues, although it may be the despair of a romantic pessimism, is no provocative to lamentation for those who understand what we do when we know.

III

Much has been made of the relational nature of scientific subject-matter. Science is not history, it does not accumulate facts to distil their unique flavor, it concerns itself not with particulars in their concreteness. Its professed and performed task is to show linkages, discover unsuspected correlations between things diversely qualified; its concern is to exhibit the *form* events possess as functions of other events. Consequently, it is never content to leave fields of inquiry disconnected, but aims to find general methods in order to unify them. Although subject-matter is delimited when studied, the ultimate goal is to push back the limits indefinitely by coördinating diverse fields.

In physics this synthesizing process finds many illustrations. Not only is its theoretical structure transformed from time to time by the "reduction" of an independent domain to a branch of another, e.g., electromagnetism to a branch of mechanics, but within some one field of inquiry a fertile generalization is introduced through the elimination of special conditions of observation and special points of approach, from the form of the discovered uniformities. In the study of dynamical systems, for example, we ask that the equations of motion be true not only when referred, say, to the sun, but that irrespective of our orientation, our velocity, or even acceleration relative to the objects considered, the laws which express their behavior preserve a certain form. This demand has been formulated as the principle that the equations of dynamics shall be covariant under every continuous transformation of the coördinates.

The most powerful mathematical instrument invented so far to eliminate the particularity of approach is the tensor calculus. It has been repeatedly hailed as the means by which we may escape from a provincial physics to a knowledge of the truly universal laws of nature. In its mathematical aspect it is the study of certain differential invariants: by its help any set of coördinates may be translated into any other set so that certain functions of the coördinates shall remain unchanged under the transformation. The calculus is therefore a kind of universal language, attempting to eliminate what

is parochial in any one selection of measure-numbers, and to concentrate upon what is common to all. In assigning measure-numbers in physics we make use of operations which do not enter *explicitly* into the equations of theory. It is advantageous to avoid connections between coördinates which issue solely from the way they are manufactured. The importance of tensors is that they attune us to a universality which escapes us so long as the accent of one set of measure-numbers is permitted, so to speak, to drown out the grammar common to all. "That which is common to all, and which is equally in a part and in the whole, does not constitute the essence of any particular thing." [12]

It is a curious turn of events, which one might suppose could occur only in a realm of fancy, did not the history of thought and contemporary discussion give other evidence, that on attaining a comprehensive outlook men are led to deny the validity of a more restricted generalization. It is by a strange irony that a method which attempts to remove a dogmatic priority for any one approach should persuade some that *no one* approach has validity because *all* are equally valid. It is a surprising reading of the outcome of science, but not an unusual one, that concludes by converting laws of physics whose derivation and meaning imply the existence of less comprehensive formulations, into hypostatic entities with a superior claim to reality than the latter. The discovery that bodies have behavior patterns should not be perverted by making those patterns the *conditions* for the existence of bodies, or by imagining those patterns to stand over against the bodies whose behavior gives to those patterns meaning; to do so is to invest the outcome of an inquiry for causal factors with an importance it does not possess outside of that inquiry. For the truth is, bodies are found in relational contexts, and relational contexts are relations between bodies.

That there always is a reference to the *individualized* behavior of bodies even in an invariant formulation of physics, is evident if we examine carefully, for example, the derivation of the equations of motion for a given "free particle" from the tensor form of the law of gravitation. Comparison of the terms of that law with coordinates having an ascertained empirical foundation is constantly made.[13] For without such matching of the terms of the general theory with experimentally well-founded concepts, no light is thrown upon what we are to expect in actual cases. If the equations of motion retain their form in all coördinate systems, it is at the expense of disregarding a host of observable features in actual motions, and while formally the equations retain a certain simplicity,

[12] Spinoza, *Ethics*, Part II, Prop. 37.

[13] Eddington, *Mathematical Theory of Relativity*, §§ 38, 47.

when their significance is sought in special cases a parochial view has to be reintroduced.[14] The *symbolic expression* of the law requires no restricted point of view, although restricted points of view are indispensable to the law. It can lead only to confusion, therefore, to maintain that the external world is a *synthesis* of appearances from *all* points of view. For if the external world is this synthesis, then any one of the elements of the synthesis, any one of the particular space-time frames of reference, is not that world. And if this synthesis acquires significance only by virtue of interpretations from particular points of view, then a quest for that synthesis is a quest for a hypostatic external world which forever eludes us.

Because the "colorless" patterns of science are after all patterns of a "colored" content, there have not been lacking resigned but melancholy sighs that science can tell us nothing of the "true nature" of things since that content is not itself a pattern. But the heroic remedy of dissolving things into relations, of displacing "substance" by "function," repeatedly proposed to give comfort against such reflections, is not certain to produce relief if we remember that invariants without a field of variables are nonsense, and that to substitute for the fulness of events a selected aspect of them is confusion. Eddington has a tale of the discovery of a volume containing the rules of chess, supposedly forgotten and no longer cultivated, but giving no indication of the shape or size of pieces, or the color of the board. "It is obvious," he remarks, "that no amount of study of the volume will reveal the true nature either of the participants in the game—the chessmen, or the field of the game—the chessboard".[15] Analogically, we are told that by no study of experiments can the absolute nature of the participants—the electrons, point-events—be revealed. What does the assumption that things have true natures not disclosed by experiment mean? It may mean that they are unknowable, or that they are not yet known, or that they are not matters for *knowledge* at all. If the first is meant, it is difficult to see why anyone should concern himself with unknowable true natures, or even know that there are any such; if the second, there is no reason for despair. If, thirdly, it is meant that true natures are unique qualities, non-communicable, to be directly possessed, it is well to remember that it is not the function of knowledge to reduplicate its subject-matter nor to devour it, that one can be in love without knowing what it means to be so, or (perhaps) acquire a knowledge of its significance (e.g., by reading Plato) without ever being wounded by the arrows of the god.

An untenable separation of theory from its application has led

[14] *Cf.* Silberstein, *Theory of Relativity*, 2. ed., pp. 366–370.

[15] *Space, Time, and Gravitation*, p. 184.

many physicists to formulate what might be called a "phenomenalism of the instrument," and to maintain that physics knows nothing of the world but pointer-readings. "The physicist's knowledge *bears* upon the nature of matter, but it *is* a knowledge of pointer-readings only." Although this manner of viewing the subject-matter of science is associated with some of the greatest names, it seems nevertheless to be based upon a misunderstanding or a gross neglect of the theory of physical measurement. Scale readings are calibrations which involve, and are taken as signs of, properties of matter established independently of many theories subsequently elaborated. Pointer-readings function like any signs; they are discriminated only after much labor, and used for safeguarding inference. To take them as primitive, and thereby generate problems concerning the reality of the flux of qualities, is on the level of a philosophy which takes cases of perception as cases of knowledge and then finds the existence of knowledge and error a problem.

The introduction of the term "reality" into physics produces nothing but confusion. Eddington writes: "He who doubts the reality of the four-dimensional world can only be compared to a man who doubts the reality of the penny, and prefers to regard one of its innumerable appearances as the real object." [16] But the point at issue is never a matter of *reality*, it is one of discovering what problems are involved and what conditions are necessary to solve them satisfactorily. Advances in science do not consist in progressively unveiling reality in the sense that layers of appearance are discovered; they consist in making our knowledge more inclusive, more unified. The success of a new theory does not relegate the old to a realm of appearance, nor does it by an act of miracle transform the truth of the old into a falsehood. A physical theory is always hypothetically entertained to explain and coördinate information already obtained, to guide further exploration. In so far as a theory is thus successfully exploited, its truth is never impugned within the field which was its original province. A new theory may be more comprehensive, assert connections of which the one discarded did not take cognizance. But on pain of committing the fallacy of affirming the consequent, within the domain that *both* theories are successful neither can be supposed to disclose reality to the exclusion of the reality disclosed by the other.

The world contains more than science affirms it to contain. Poetry, music, love, and friendship, teach us much never to be discovered in the laboratory or the study of the mathematician. But if we ask what minimum features of the world science can reveal, the answer that must be given is that nature is a realm of continuity or

[16] *Loc. cit.*, p. 182.

necessity, and a realm of individualized events. The world is much more than this, and any survey of it which reports these features to be all there is, is arrogant in its claims. But because science does not exhaust the wealth which is nature, and pays for the enlightenment it brings by illuminating only a segment of that wealth, does not make it partially false.

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MEANING

IF one were to meet his eccentric friend of a dark evening and in a lonely place and were to have it whispered in his ear: "I think the moon is made of cheese for tomorrow will be Sunday," he will be tempted to assume, we may be sure, though too precipitately perhaps, that he has been listening to a phrase that has gathered no meaning, that possesses no meaning in itself. For while the last of the assertion might amount to certainty itself and the first be even playfully arguable, it is the manner of bringing them together that appears grotesque. To see or to seek a causal linkage between the parts seems, at first blush at least, an unprofitable undertaking.

But suppose the facts are these: This man is the victim of a mania, not indeed continuous but recurrent, the sharer of a belief that returns to him periodically, that is to say, on Saturday night. Suppose, now, that you have a prior acquaintance with this fact, is not the whole face of the situation changed? For then, and only then, has it come to have a meaning. You may, indeed, debate how far your friend's belief is serious and real, and you may question his confidence in the accuracy with which he predicts its periodic return: that is, you may debate if what he says is true or false. But just because it is thus debatable, the assertion, literally meaningless, has begun to gather meaning. *A meaningful statement is one that is either true or false and, contrariwise, a meaningless statement is one that is neither true nor false.* In the case contemplated, then, our conclusion should not be: "This assertion is meaningless," but rather this: "This assertion is meaningless or else there is some hidden, some undiscovered but relevant, fact that may yet put meaning into it."

"I bought a green hat today because the Esquimaux have flat feet." Can one debate if this is true or false? Does it not appear meaningless enough? Or rather, shall we say, the way of relating the parts appears inappropriate to the parts. To express the matter technically: the relation and the parts it joins do not appear to enter into any system. It happens, however, we may suppose, that

I myself am in a position to know related facts that another might pass by unobserved. I know, for example, that my wife is not inspired with pride because of the hat I wear and that her choice among hats includes one that is green. Now last night I dreamed, we will assume, that Esquimaux women prefer men without flat feet, because among this people such men are rare. And though I have forgotten the dream, the next day finds me in town and in search of a green hat. Hence the conclusion, right or wrong if you like, but at least arguable: "I bought a green hat today because the Esquimaux have flat feet." Our thesis, which may now be stated baldly and without more ado, is this: *An assertion is meaningful in proportion as the question of its truth or falsity can be made an issue either of experience or reflection.*

While it may well be that the question of the truth or untruth of a given proposition could never become an issue of pure reflection without reference to experience, or again, of unreflective experiment, there are certain limiting cases, which have always attracted the imagination of the philosopher because they are critical. On the one hand stand judgments concerning the data of sense which are assumed to be given "immediately," on the other those pure definitions of the meaning of terms "concerning which doubt is impossible," the axioms of logic and mathematics, the "first principles" of philosophy.

The great historical movement which has felt most keenly the critical nature of the first class of judgments, as a limiting case, is empiricism. What is the criterion of empirical certainty, the nature of experimental evidence? It is assumed that no existing fact is beyond the reach of the experimental method; that every fact is observable, could we but know how. Nature is the sphinx to whom all questions may be put, even if it be indeed the master experimenter alone who can extort an answer. Or, otherwise, to cite a fundamental article from the author's own philosophic creed:[1] *A judgment of fact which can receive no experimental confirmation is neither true nor false because it is meaningless.* The position of mysticism might well be defined as that of any philosophy which denies this first assumption of science's image of the world, those faiths, and all those faiths, which can give no "reasons" for the faith that is in them.[2]

[1] *Cf.* "Postulates of Empirical Thought," this JOURNAL, Vol. XXV (1928), pp. 318–323.

[2] If we have here in mind certain faiths "handed down by the fathers," we mean to include much more. For example, *der Sprung ins Jenseits*, the assumption, that there is an infinite number of *actually existing* points on a line, a fact which is thus by definition unobservable. The paradoxes of the Mengenlehre are, in the writer's opinion, the fruit of a scientific mysticism. And

It is those other judgments which deal with "pure" definitions of what terms mean, that have preoccupied the mind of the rationalist, he for whom the *credo ut intelligam* has given way to the *dubito*. What, then, are these indubitable truths and can a better test than the *clara et distincta perceptio* be devised? Or, more accurately, can this test be reinterpreted and given sense? Is it not indubitable that "equality" is reflexive, symmetrical, and transitive? Can it be debated if "every *a* is an *a*"? The answer which the later rationalism of Leibnitz gave to this critical question might be boiled down to this: *An assertion is beyond doubt when it has once been shown that its denial leads to its reassertion.*[3]

These two assumptions—the postulate of empiricism, the postulate of rationalism—would constitute, then, a species of definition that would render our principle of the sense in which meaning is to be understood, applicable to the historic judgments we have just described.

There is in the definition of meaning a logical subtlety that deserves to be pointed out. A meaningful assertion is one that is either true or false, but such an assertion may well be *specifically* neither true nor false. Such are the propositional functions which have been recognized by all logicians from Aristotle down, statements whose truth or untruth depends on the meaning assigned to the terms that enter into them. A famous case is given by Kant's key to his solution of the difficulty involved in the idea of the totality of appearances in a world-whole. The world is, in respect to its spacial boundaries, he says, either finite or infinite, but it is specifically neither one.[4] Let the statement be: The world is, with respect to its spacial boundaries, infinite. Is this, then, meaningless because it is neither true nor false? And Kant's answer comes clearly enough: The statement is either true or false, you may say, but it is specifically neither one.

The problem of Epimenides furnishes us with another example of the same sort. For the sake of convenience we may consider the

again, there is the substratum of Locke, Kant's thing-in-itself, Spencer's unknowable and so on throughout the wide range of those other mythologies of the spirit.

[3] In a monograph entitled *Non-Aristotelian Logic* and published about ten years ago the writer has developed a logic in which the axiom "all *a* is all *a*" is denied. Obviously this logic can be refuted by no experimental evidence. It can be shown to be self-consistent provided the classical Boole-Schroeder system leads to no contradictions.

[4] "Ich werde auch nicht sagen: der Regressus von einer gegebenen Wahrnehmung an, zu allem dem, was diese im Raume so wohl, als der vergangenen Zeit, in einer Reihe begrenzt, geht ins Unendliche; denn dieses setzt die unendliche Weltgrösse voraus; auch nicht: sie ist endlich; denn die absolute Grenze ist gleichfalls empirisch unmöglich" (*K.d. r. V. Originalausgabe*, S. 548).

paradox in the familiar form of the assertion: "This proposition is false." If this case be examined critically, we will find that we have on our hands an ambiguity of an unusual kind, viz., an assertion that is equivocally true or false; or, in technical terms, a two-valued function whose truth-values may be taken to be ambiguously zero or one. Now an ambiguity is only vicious when it passes undefined. Were we properly to define the part: "this proposition" and the part "is false," we should discover, perhaps, that no paradox could arise. Thus, if "this proposition" is a two-valued function, being ambiguously zero or one, then "this proposition is false" is similarly two-valued and no contradiction can arise. The difficulty reduces to that of the fallacious use of "all" in the distributive and collective sense. "This proposition" and "this proposition is false" are equivalent for all meanings collectively, but not for all meanings distributively. The statement, "This proposition is false," is either true or false and is therefore meaningful, but it is specifically neither true nor false. It is the failure to take account of these distinctions that has led certain writers to classify such assertions as of the meaningless kind.[5]

More than one school of thinkers has brought the charge against formal science and against science generally that it abstracts from the meaning of its terms and so "falsifies" that nature whose instrument it is taken to be. Such thinkers are hard to meet on their own ground; not, indeed, because there is something that is sound in what they say, but because they have never entered deeply enough into the tradition of science to have gained a sympathetic understanding of its dignity and a respect for its aims. A forensic argument will convince none who has rejected in advance the ideal of science and its instrumental worth. All science abstracts from specific meanings in proportion to its generality and to have missed this fact is only to have misunderstood the issue and the critical point. What motivates the development of method is in larger part the tendency to generalization, the process by which unnecessary limitations are removed through the extension of the meaning of terms and relationships, limitations whose restrictive nature was perhaps not suspected when the original (historic) definitions were set down. Concepts, of course, have no meaning in themselves. They acquire meaning in the context of those judgments into which they enter as constituent parts.

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[5] A technical solution by the writer of the difficulty that is here discussed will appear in a coming issue (Jan.–Feb.) of the *Bulletin of the American Mathematical Society* under the title: "The Theory of Multiple Implication and its Application to the Generalized Problem of Epimenides."

THE LIMITATIONS OF SCIENCE

MY colleague, Professor Lillie, in a thoughtful article [1] stresses the scientific ideal of defining the conditions of natural processes in exact quantitative terms as an indication that science deals only with constancies, uniformities, and repetitive phenomena. The individual or unique phenomenon in its isolation is unapproachable by the scientific method.

He brings out, further, the fact that organic evolution seems to exhibit a progressive movement toward individuation. All electrons are alike intrinsically. At the other extreme every man is intrinsically unique and intensely individual.

"The individual, as such, is not the subject of science." Accordingly, "The more unique the individual is, the less do general rules apply—the freer he becomes; i.e., since science is general statement, the less does the scientific method apply. Hence life in its highest manifestations—of individuality and value—is inaccessible to science."

To get this conclusion in its proper setting one more sentence should be quoted: "I find at the end of my discussion the philosophical and scientific aspects of my subject have become fused and inextricable."

Clearly throughout this paper the author has been writing, not as biologist, but as philosopher, in both of which fields he is qualified to speak with authority. To the biologist who is not a philosopher it would seem very desirable to attempt to disentangle the threads which are here so artfully woven together—this in the interest of clarification of scientific procedure.

It is true that an isolated phenomenon can not be studied scientifically, for science is interested primarily in the relations of things. But did anybody ever experience such a phenomenon? Our most intimately personal feelings, motives, sentiments, appreciations, and values are not isolated events. They stand in relation with antecedents and consequences, with causes and effects, with various assortments of objects, persons, and events. These relationships are not disorderly and they may be readily classified according to their resemblances and differences, that is, they may be treated scientifically.

The objects of science and the tools of science are all abstractions, as Professor Lillie has elsewhere emphasized. Science never envisages ultimate reality, the thing-in-itself, for experience gives us only partial views. As a realist the scientific man recognizes that the

[1] Lillie, Ralph S., "The Scientific View of Life," this JOURNAL, Vol. XXV (1928), pp. 589–606.

"real things" with which he deals as chemist, as microscopist, and as practical man are incomplete fragments of, or perhaps merely symbolic expressions for, the underlying intrinsic realities.

As philosopher he is interested in these inaccessible intrinsic realities, but as man-of-science he can not explore them, for they lie beyond his experience. The uniqueness of the individuality of these ultimate intrinsic realities we could not explore scientifically, even if we could experience it, for the reason already mentioned. But the sensible fragments or indicators of these realities that do come within our ken can be treated scientifically because they are experienced in relation with other things.

In a similar way our most intimately personal and solipsistic experiences of appreciation and value, while not amenable to scientific treatment in their individual and unique characters as private passions, are nevertheless not beyond the pale of science. The relations of these experiences can be studied scientifically.

To this it may be objected that this is all to one side of the point because the relations of the thing are not the thing in its absolute essence.

That may be true philosophically, but I maintain that in science the objection has no force; for empirically the thing *is* its relations, and it is nothing more than this for science. Having explored these relations, we have gone as far as we can go in science, whether we are dealing with electrons, silver dollars, or the sentiment of filial piety. If electrons, which we have not experienced, can be treated scientifically by an indirection, I see no reason for denying the appropriateness of a scientific approach to piety, which we have experienced, by another indirection. The approach is different, but the method seems as valid in the one case as in the other.

The philosophical implications of the two cases, I grant, may be very dissimilar; and the fact that I personally have experienced the sentiment of piety may take me much closer to the essential or intrinsic nature of a sentiment than I can ever hope to get to the essential nature of an electron. On this point as a naturalist I can not express an opinion, for the essential nature of things is not a scientific problem.

As a naturalist, I claim the same right for the psychologist to study a sentiment or a value scientifically as I claim for the physicist to study an electron scientifically. In both cases the study is of empirically determined and verifiable relationships. It is a difficult task in both cases, but probably it is not so difficult for the psychologist to make headway as for the physicist. The psychologist can observe the physical and mental antecedents of the sentiment and its physical and mental consequences. Some day he may be able to get

reliable data on the actual operation of the cerebral mechanisms which are at work during the progress of the elaboration of the sentiment. With the aid of language and other symbolisms he can compare various people's description of the experience. And, most important of all, he has an immediate awareness of the experience which he can repeat and compare in retrospect. Here he has a decided advantage over the physicist, who can never hope to remember having been an electron.

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BOOK REVIEWS

Idealism as a Philosophy. R. F. ALFRED HOERNLÉ. New York: George H. Doran Co., 1927. Pp. xx + 330.

Professor Hoernlé describes philosophy as the "love of wisdom" whose source is the "deep-seated need in the human mind". . . "to feel at home in the universe" (23), and whose "goal is a vision of the Real which shall satisfy both head and heart," an insight which will enable us "to understand the universe and to approve—nay, to love it" (24). He describes the leading types of idealism as interpretations of the universe in terms of spirit, and to the nature of spirit he takes our value-experiences to be the best clues. If successful, philosophy must interpret the universe as satisfactory to "head and heart," and if idealism is the philosophy which takes values seriously and explains the universe in terms of them, it is a fairly direct inference that idealism is the most promising road to the philosopher's goal. But both of the premises of this argument have to be challenged. First, there are excellent reasons to define the goal of philosophy as an understanding of the cosmos influenced as little as possible by the human longing to find it hospitable. And second, recent naturalistic and realistic interpretations of the nature and orders of values have been at least as enlightening as idealistic interpretations. Professor Hoernlé argues that of all philosophies idealism achieves a preëminent concreteness by its success in "taking up into itself" all modes of experience (including feeling and action, art and religion) and in bringing to light their "real nature" or "truth." Many readers will find here the fallacy of Hegel's doctrine of philosophy as the "truth" of art and religion. A successful philosophy, whatever its metaphysical tendency, may analyse the characters of esthetic and religious objects and experiences; but if the philosophy is rational thinking it can not pretend to apprehend or express the concrete content of these objects and experiences.

Such apprehension is the work of religious and artistic intuition, and such expression is the work of the arts.

Professor Hoernlé reckons with both of the above challenges. If he hopes to see philosophy make men more at home in the universe, it is mainly by means of the rational transformation of their hearts' desires. And if the universe is to be understood in terms of spirit, Professor Hoernlé argues that spirit can not be taken as anthropomorphic or as abstractly logical, but must be understood as the objective world of science, art, religion, morality, politics—or rather as the absolute completion and synthesis of these and of their natural conditions, which synthesis is said to be their implied ground as well as their consummation. These positions revive difficulties prominent in the writings of Bernard Bosanquet, to whose memory the present book is dedicated. Bosanquet lessens the awkwardness of interpreting the universe as spirit by enlarging the conception of spirit into something very like that of the order and substance of nature. However, Bosanquet is not reduced to saying merely that nature is nature. He insists that spirit has still a specific and proper meaning, in the light of which nature can best be understood. To save this specificity he resorts to such doubtful courses as the inference that nature, as mechanical, is encompassed by and grounded in a context organic and teleological. Neither Bosanquet's ingenuity nor Hoernlé's has resolved the dilemma: if spirit is what we experience it to be (or reasonably infer it to be from our experience), there is no ground to suppose that it is the universe or the central fact in the universe; on the other hand, if the universe is spirit, then spirit is something we have never experienced as what honestly goes by that name.

The chief purpose of Professor Hoernlé's book is not to defend idealism, but to provide a "map" to guide beginners "through the mazes of idealistic theory." To this end Professor Hoernlé has prepared a convenient analytical table of contents and has taken great pains to introduce technical terms gradually and with adequate definitions. After admirable preliminary treatment of such matters as the attitude proper to philosophical study, and the distinct meanings of "idea" and "ideal" in various disciplines and at various historical stages, he distinguishes the four types of idealism which he is to explain and criticize: Spiritual Pluralism (represented by Berkeley and James Ward), Spiritual Monism (represented by Schopenhauer and Bergson), Critical Idealism (Kant), and Absolute Idealism (represented by Hegel, Bradley, and particularly Bosanquet).

The chapters (III and IV) on Berkeley's philosophy and its development are of great interest and should help to check the ten-

dency to prefer praising or denouncing Berkeley to understanding him. Professor Hoernlé indicates Berkeley's modernity in opposing "the bifurcation of nature" and the consequent representative theory of ideas. He makes it clear that Berkeley's ideas are objects, not modes (states or processes), of perceiving minds. But when he points to the parallel between this view and modern realistic theories of objects as classes of sense data he does not warn us of the ontological difference produced by Berkeley's doctrine (later explained) that all ideas are causally produced by God—that finally, indeed, there is nothing "which is real and yet not a mind or spirit" (146). Professor Hoernlé criticizes the weakness of Berkeley's doctrine of active spirit (of which we have no idea); but he is inclined to save Berkeley by arguing that his "notion" of spirit is justified by what seems to him our indubitable immediate acquaintance with mind as active in perceiving ideas. Professor Hoernlé seems to agree with the arguments by which Berkeley "eliminated" the concept of substance "from our thinking if not from our grammar." But he does not distinguish substance as Lockeian substratum from substance in the Aristotelian sense of compound of essence and "material cause," or in the modern sense of charactered occurrence. Lockeian substratum Berkeley indeed demolished (as Aristotle and others had done by anticipation), but substance as charactered occurrence Berkeley eliminated as an object of knowledge only if he proved that we perceive nothing but essence, and never events. To the reviewer there seems to be a stronger case for the perception of occurrence (in itself neither physical nor mental) and hence of substances as more than collections of "ideas" or complexes of essences, than for the perception of mind as active in perceiving.

Chapter V is mainly concerned with the philosophy of James Ward and with Professor Hoernlé's objections to spiritual pluralism. It contains an interesting account of the nature and limits of proof in metaphysics. It appears to approve as a fundamental article of philosophical faith the dubious principle that "it can not be rational to believe in an irrational universe" (143). Some such article of faith prompts many more or less theodicean statements throughout the book to the effect that error, evil, and unintelligibility, while actual, must be factors in a total situation everyway perfect,—that suffering, for example, must be (or be capable of being transformed into) a way of salvation. The chapter also contains the astonishing comment on "mind, soul, spirit": "These three terms are always used as *synonyms* in philosophical discussion" (130). Unless the italics are meant to signify that "synonyms" is to be taken in an uncommon sense, one must wonder what Professor Hoernlé does with the distinctions between νοῦς and ψυχή in Plato and Aristotle, and between *Geist* and *Seele* in Hegel.

Professor Hoernlé gives short shrift to spiritual monism as negating all distinctions of quality. His chapter on the subject (Chap. VI) is notable for its discussion of the contradiction between the Berkeleyan and voluntarist strands in Schopenhauer's metaphysics, and of the vexed problem of matter in Bergson's account of nature in terms of the Life Urge.

Chapter VII deals with Kant's critical idealism as an analysis of the way in which men *must* think if they are to know the world scientifically (179), and not merely of the way in which some men *did* think as a matter of fact. The problem of the extent to which Kant's analysis stands or falls with the science (especially the mathematics) of the eighteenth century is not raised. Typical of the chapter is the statement (184) "that even for ordinary common sense, let alone science, Nature is not a mere stream of sense data, but a world, a system, a whole ordered according to laws." Whether this opinion is offered as Kant's or as Professor Hoernlé's, or as the opinion of both, it needs more criticism than it gets . The questions whether nature is actually perceived "as a world," whether such necessary *a priori* laws as there may be are not "analytic" rather than "synthetic," whether the regularities implied by "system" are more than hopes, guesses, or more or less rough but useful averages—these questions will all have to be answered before such a view as that stated can be regarded as justified.

After warning us that the categories and the unity of apperception are objective, Professor Hoernlé tends to seat them in "mind," but probably no more than Kant himself did. Especially valuable is his explicit account of the respects in which the *Critique of Judgment* (by arguing that the world may be really and thoroughly what our spiritual experience demands) leads away from Kant's metaphysical skepticism towards an idealistic ontology.

The transition to the account of absolute idealism is made by an interpretation of the development from Kant to Hegel. Instead of the usual sketch which makes this development center around a few problems (like those of the *Ding-an-sich* or the unity of apperception), Professor Hoernlé succeeds in giving us an impression of how Hegel's dialectic may be understood as growing out of the whole synthetic method and tenor of Kant's work. Absolute idealism is presented as avoiding the problems of communication between spirits (so difficult for spiritual pluralism), without negating qualitative distinctions as monistic idealism is alleged to do. It leaves Kant halting at the threshold which he discovered, and, crossing, appropriates the mansion of positive spiritual ontology.

Professor Hoernlé's account of absolute idealism will be welcomed as an excellent summary. It adds little to the position of

Bosanquet, except a convincing and needed argument that idealistic political theory does not preclude (as Bosanquet seems to have supposed) loyalty to political communities which transcend and include "sovereign nations."

Professor Hoernlé's book sets before us the great virtues of German and British Idealism. It has avoided some of the worst blind alleys of epistemology, and of Cartesian dichotomies, by taking as real (if only a phase of the whole reality) what is perceived and thought. It has striven to understand all things in the widest possible context. It has insisted that the place to study mind is in its concrete history, and its fullest and richest creations. But in spite of Professor Hoernlé's sympathetic exposition, the impression will remain with some readers that idealists have wrongly supposed that such virtues can only (or best) be secured by a philosophy which views spirit as ultimate and which explains the creation and maintenance of the "worlds" or "organs" (art, religion, society, "nature") through which the absolute "realizes itself" by analogy with the self-transcending but self-enriching human experiences of devotion to mate, children, science, country, God. If some readers will doubt whether the full appreciation of spiritual achievements requires an idealistic metaphysics, more will doubt whether the considerations urged by Professor Hoernlé make such a metaphysics probable. To the discussion (more independent than was possible in the present book) of such issues, the admirers of Professor Hoernlé's *Studies in Contemporary Metaphysics* will hope to see him turn.

The book is well printed. The reviewer has noticed only half a dozen typographical slips—one of them almost too amusing to be regretted: the ascription to the Bishop of Manchester of a book called "Men's Creatrix" (320).

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The Organization of Life. SEBA ELDRIDGE. With an introduction by H. S. Jennings. New York: T. Y. Crowell Co. 1925. xv + 470 pp.

Mind and Body. HANS DRIESCH. Translated by Theodore Besterman. New York: The Dial Press. 1927. Pp. 191.

Eldridge's book is to be prized as an illustration of philosophical combined with biological method, and as an opportunity, in the words of H. S. Jennings, to judge the fruits of "extensive ratiocinative treatment of scientific data." We may accept Jennings' judgment that it supplies a clear and comprehensive "map" for the biologist, to tell him whither this theory or that will lead him if he

adopts it. We must wait until the biologists inform us whether, as Eldridge hopes, this work serves to stimulate and guide observation and experiment and inductive thought. But we may for ourselves judge whether it serves the *philosophical* purpose of making the world intelligible. To this third question this review is devoted.

The "organization of life" is approached through its central problem, that of phylogenesis. Here we find contrasted the neo-Lamarckian hypothesis and its opponents. The former states (p. 15) that "a certain type of hereditary variations is due to *specific* or *representative* effects of functional (physiological) activity" in the organism. The latter may adopt one of two positions:—either, resting its case on the segregation and continuity of the germ plasm, it denies that functional activity is causally effective in heredity; or else it asserts that functional activity, while causally effective in heredity, is not *represented* in hereditary effects (e.g., reactions to toxins or nutritive elements may affect the germ plasm and heredity, without being *represented* in heredity by similar reactions).

This biological problem assumes philosophic importance when it is seen that neo-Lamarckism as here defined rests upon and implies general principles of method, in such a way that, if observation and experiment discredit neo-Lamarckism, then these principles of method, these underlying assumptions, must also be abandoned, in whole or in part. These underlying principles are variously stated by Eldridge, but may, I think, be summed up in three propositions.

(1) The several properties of life and evolution appear always in *indissoluble association.* These "properties" are physico-chemical, functional (physiological), and reorganizing (morphological, organizatory). On pages 292, 293, however, are listed eight such properties, including mental, cultural, spatial, temporal, logical, and mathematical factors, as well as sub-physical and organizatory factors. Of this first principle neo-Lamarckism is but a special form (pp. 173, 434).

(2) These properties are not merely descriptive categories, but are *factorial processes* that are causally operative in events (p. 455). This principle frees Lamarckism from any necessary association with the Driesch theory of *entelechies,* while securing it the support of the observations and experiments to which Driesch points in support of his theory.

(3) The causes of events in any system of phenomena are internal to that system (pp. 436, 173). This principle is one of the "fundamental postulates of all science," and is incompatible with all anti-Lamarckian theories, since these all "lead logically to the supposition that external agents have intervened in the process of phylogenesis" (p. 173).

The method of which these principles are characteristic is as a whole appropriately styled one of "*factorial analysis.*" It is adapted to psychical and social as well as to biological phenomena. Eldridge relates it not only to phylogenesis, but also to cosmic evolution; and there he holds that Bergson's *élan vital* is incompatible with the principles enunciated above. But in so doing he attributes to Bergson a belief in pre-existent *moulds* where Bergson himself speaks of tendencies and processes. It is in this account of *factorial analysis* that I find the chief value of the book, at least for philosophers.

Consequently I regret that to me Eldridge appears in the later part of the book to abandon this method, on the ground of certain metaphysical assumptions (p. 440); which may perhaps for convenience, and without substantial loss, be reduced to two:—the existence in nature of *imperceptible* entities; and of *necessary* connections. In the absence of any account of the relation of perception to reflection his meaning here ceases to be clear; while in fact he appears to abandon the method and outlook of factorial analysis with which he began. For here we are given a long list of categories, and of corresponding entities, without that account of observable *process* which the term "factor" had hitherto implied. Indeed I find it impossible to reconcile this involved discussion of alleged entities with those more happy passages in which it was recognized that these factors are "indissolubly associated," so that it is "impossible to apportion credit among them for the changes produced" (p. 5).

"Philosophy without Psychology is bare and empty; Psychology without Philosophy is blind," says Driesch in his preface. The first part of *Mind and Body* is given to showing that the degree of manifoldness of the mental differs from that of the physical so far that psycho-physical parallelism is inadmissible. The second part is given to establishing a new parallelism between *three* orders of being: viz.: (1) my stock of conscious content; (2) this state of my mind as particular sphere of being; (3) non-mechanical factors, (*psychoids*), or unconscious mental factors in nature. To the reviewer it seems perfectly clear that of these three orders, only the second is treated as existent. The first is merely the tracing out of logical implications from the second; the third order is merely an imaginary hypostatization of the second.

This work of Driesch, therefore, appears to me to illustrate admirably the method of inquiry that neither enriches philosophy nor clarifies science. In the first part of his book Eldridge, on the contrary, illustrates the method that may render service to both.

Yet Eldridge in his account of "imperceptible entities" wanders

far from that "factorial analysis" with which his work opens. In that analysis he enriches philosophy by outlining with some distinctness principles of method which it seems may actually be put to the test by biologists. He clarifies also the vision of the biologist by showing on the one hand the weaknesses inherent in the commonly accepted theories of phylogenesis, while on the other he frees Lamarckism from unessential vagaries. He would render similar service to philosophy and psychology were he to subject to analysis what he terms "a fundamental postulate of modern science" (page 425), viz., that the knowledge of the world about us is *derived from* functional adaptive activity in relation to that world. This biological approach is precisely what to-day obstructs psychological advance. Unprejudiced observation of animal and human behavior makes it clear that knowledge and adaptive activity are, in Eldridge's words, "indissolubly associated." One is not *derived from* the other.

Eldridge's book is on the whole a most excellent exercise in a much needed analysis of biological concepts. Its weakness results, as I have tried to suggest, from partial neglect of the principles and the method with which he started.

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NOTES AND NEWS

The Société Belge de Philosophie announces the first number of a new philosophical series called *Archives de la Société Belge de Philosophie*. The editor is M. Barzin and the address is 6 Avenue Livingstone, Bruxelles. The first number is a monograph by Professor Eugene Dupréel of the University of Brussels entitled *De la Nécessité*. From the announcement we quote: "In adopting the flexible form of "Archives," appearing at irregular intervals (a number containing reviews and analytical notes will appear at least each year), the Society seeks to guard against the future and not to discourage contributions which are too long to find a place in the narrow confines of a fixed journal."

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